Invasion History of the Alien Red Swamp Crayfish, *Procambarus clarkii*

The red swamp crayfish, *Procambarus clarkii*, is one of the most popular among astacologists and it is of economic importance in many countries. Native to southern USA and northeast Mexico, this species has been intentionally translocated to Asia, Africa, Europe, South America, as well as the western and eastern sides of North America. For example, the first introduction to Asia from Louisiana, New Orleans, was motivated by farmers who used crayfish as food for breeding bullfrogs in 1927 (Kawai and Kobayashi, 2011). However, since the 1960s, the red swamp crayfish was mainly introduced outside of its native range to set up a similar harvesting system as the farmers in Louisiana State had done. In fact, the red swamp crayfish has been harvested for commercial activities in North America, Africa, Europe and China, where the species has subsequently been translocated by human (secondary introductions), leading to a rapid spread worldwide. Therefore, unravelling the complex history of this highly invasive species represents a relevant step in understanding its global invasion process and is of vital importance to establish efficient strategies for controlling or preventing future invasions.

Recently, one paper has showed the main invasive routes of the red swamp crayfish as well as the genetic differences between native and invasive populations in the Northern Hemisphere based on molecular techniques (Oficialdegui et al., 2019). To do that, a total of 1416 mtDNA sequences of the red swamp crayfish from 122 populations (22 native and 100 invaded) were used. Our results confirmed several invasion routes reported historically and unveiled others that were not previously described. For example: two invasion routes eastwards and westwards from the native range in the USA; the small propagule pressure (few individuals were translocated) in the introduction to Japan and subsequently to China; the introduction of the red swamp crayfish from Louisiana to southern Spain and, from there, multiple secondary introduction events took place to the rest of the Iberian Peninsula, the south of France and Italy; and also, the appearance of an unknown haplotype in the north of the red swamp crayfish distribution, absent in southern populations, suggested that other introduction events could have occurred in Europe (Figure 1). Additionally, we found a high haplotype diversity in the native range, but also in some non-native areas such as western USA and some diversity hotspots in Europe (e.g. southern Spain or Italy), suggesting a complex pattern of multiple introductions with many introduction events and individuals involved. All these findings suggest that the invasion patterns of the red swamp crayfish are more complex than generally assumed.

For decades, the red swamp crayfish has been commercially used as seafood and has also been sold in shops. This fact could have caused accidental or deliberate introductions (Continued on page 7)
into the wild. For instance, the red swamp crayfish was sold in department stores or night shops of Changchun City, southwestern China, in August 1939. The cost of one specimen was around 50 Japanese Sen (100 sen = 1 Japanese Yen) so that the value of 50 Japanese Sen in 1939 could be exchanged to 3 USD/specimen in 2019. An exchange based on the website of the National Diet Library, Japan (information was downloaded on 1st September 2019). Although this cost is approximate, the price of one specimen seems to be not too expensive and affordable to anyone. Thus, this reasonable cost of the red swamp crayfish in China could have facilitated its rapid spread across East Asia in the beginnings of the invasion. This approach could be similar to the pet trade nowadays. Therefore, more effort to control the trade involving highly invasive species should be taken due to their ability to be established, thrive and spread rapidly causing severe damage over non-native ecosystems.

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References

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